TECHNICAL REPORT NO. 74-61

MINICOMPUTER (TECMAT)

by

John P. Francis, Sr.
Communications & Electronics Branch

June 1974

Final Report

U. S. ARMY LAND WARFARE LABORATORY
Aberdeen Proving Ground, Maryland 21005

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Minicomputer
Nova 1210 Central Processor
Linc Tape
T.I. Silent 700 Data Terminal

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Minicomputer is a small off-the-shelf digital computer. The Central Processor is a Nova Model 1210 with 16K Core memory. Also included was a Linc Model 600 Magnetic Mass memory with dual drives. The data terminal is a Texas Instrument Silent 700 keyboard printer with a writing rate of 30 characters per second. Also included is a REMEX high speed paper tape reader. The Minicomputer was evaluated by an Engineer Group and a Battalion in Germany to determine effectiveness of such a computing system for management and engineering problems.

AD-782943

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INTRODUCTION

On 15 October 1968 a "Memorandum of Agreement" on Test and Evaluation of Commercial (Off-the-Shelf) Material and Equipment (TECMAT) was consummated between Headquarters US Army Combat Development Command (CDC) and US Army Limited Warfare Laboratory, now US Army Land Warfare Laboratory (USALWL).

In March 1971 USALWL was requested by CDC to investigate the applicability of commercial Minicomputers (under TECMAT program) for test and evaluation by Engineer Group and Battalion Units. Since a suggested cost limit of $25,000 per copy was established, a study was undertaken with the aid of the Engineer School to determine the most cost-effective system. It was agreed by USALWL, Office of Chief of Engineers, The Engineer School and CDC that the following components would be appropriate for the evaluation: A Nova 1200 Series Minicomputer with 16K Core memory; a Linc, Magnetic Tape Unit; a Remex High Speed Paper Tape Reader; and a Texas Instrument Keyboard Printer Terminal. USALWL was to procure the equipment, conduct limited environmental tests and introduce the computer to the field evaluators. The Engineer School was to provide the programs (soft ware) as requested by the evaluators.

This report discusses the test and evaluation of the assembled computer by the US Army Land Warfare Laboratory at Aberdeen Proving Ground, MD, and the 24th Engineer Group (Construction) in Germany.

DESCRIPTION OF EQUIPMENT

The equiment consisted of a Nova 1210 Center processor (Data General) equipped with 16K Core memory, automatic program load and automatic voltage control; a Linc Model 600 dual tape transport made by Computer Operations; a Texas Instrument "Silent Seven Hundred" Keyboard-Printer which can print 30 characters a second; and a Remex Highspeed Paper Tape reader.

All of the equipment except the terminal was mounted in a Scientific Altantic Half Rack with a tabletop (Figure 1). Also included in the rack was a "total-time" meter. A Topaz Converter was provided to convert the German commercial power (220 volts at 50 cycles) to 110 volts at 60 cycles required by the Linc 600. The Nova 1210, the T. I. Silent 700 and the Remex had built-in provisions to switch from US power (110 volts at 60 cycles) to the German power (220 volts at 50 cycles). The Linc 600 uses reels of magnetic tape which are 150 feet long and 3/4-inch wide, two reels are used on the machine. Each reel can store 102,400 sixteen-bit words as well as the pre-recorded clock and block numbers. The T. I. Silent 700 data terminal uses a thermal type paper. Spare parts for the Remex tape reader and the Linc magnetic tape unit were supplied as well as fuses of appropriate rating for all units.

Pre-programmed tapes containing the operating program systems were provided for the Linc Tape Operating System (LTOS) which includes Automatic Program Load, Editor-Complier, Basic, Files, etc. A Fortran IV System also was provided.

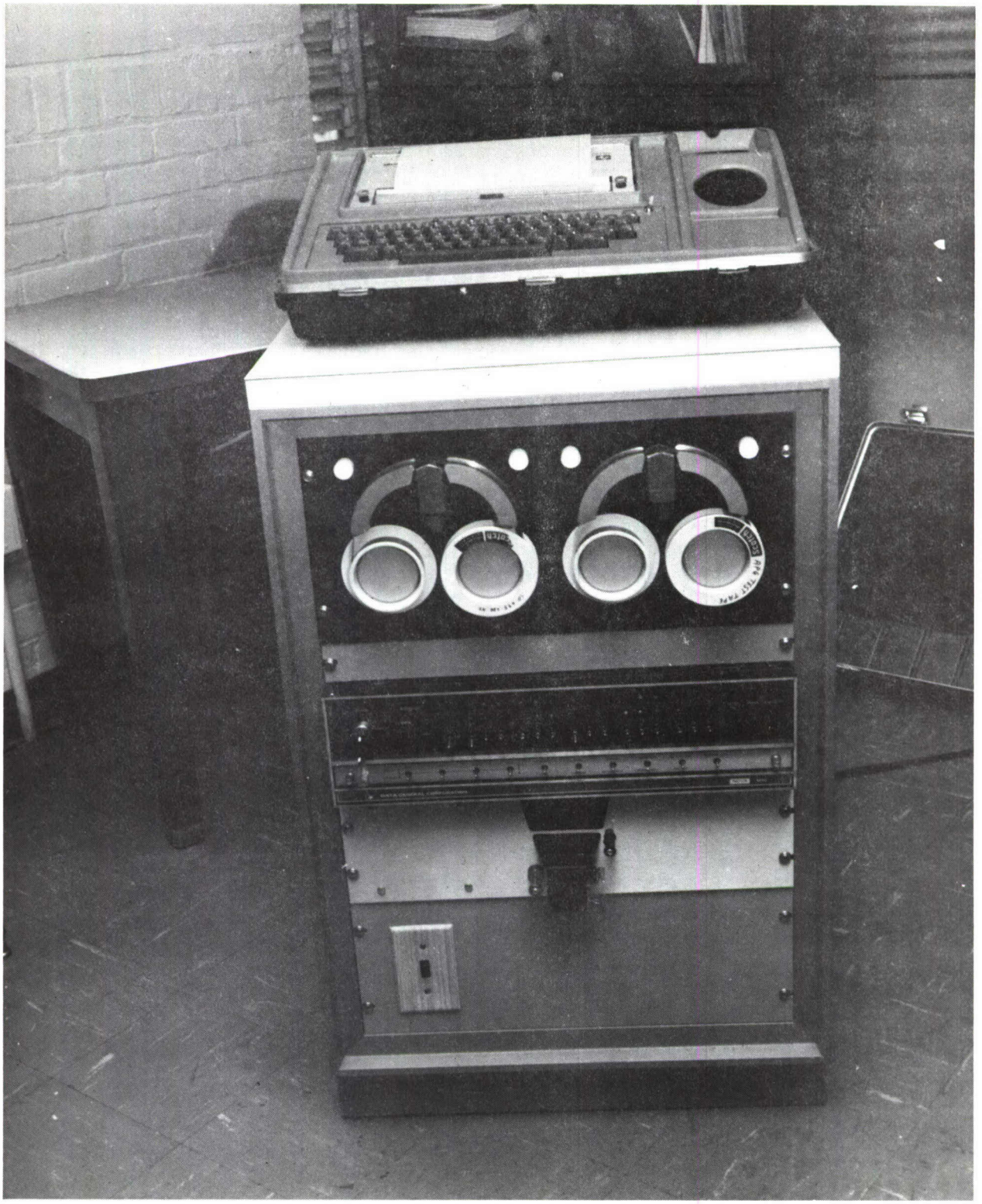

Figure 1. Minicomputer Set-Up for Operation

TEST AND EVALUATION

USALWL Preliminary Tests. After the delivery of the complete system to USALWL the computer and peripherals were checked for operation of all functions. After minor adjustments, the system was subjected to limited environmental tests. The report of the environmental test is included in Appendix A.

Operational Evaluation. The operational evaluation started the first week of October 1972 with the USALWL Project Engineer, Mr. J. P. Francis, and a representative of the Engineer School, Lt Dale Bryant, delivering and installing the equipment at the Hq 24th Engineer Group, Kaiserslautern, Germany. The equipment was set up and the first management programs were prepared. The assigned test officer, Lt Understock, was in charge of the evaluation. The evaluation plan required the use of the computer system at Group Headquarters for 6 months and at Battalion level for 6 months. The Group Command requested and was given approval to extend the evaluation at Group level to July 1973. At that time, the system was forwarded to the 293rd Battalion at Baumholder and the test officer was replaced by Lt Lott, an Officer with training in automatic data processing (ADP). As shown in the report from the 293rd Battalion and as endorsed by the 24th Group, the usage at Battalion level was not conclusive. The Evaluation Plan approved by LWL, Engineering School, Office of Chief Engineer and CDC for use by the Engineer Group and Engineer Battalion is included as Appendix B. The evaluation results are given in Appendix C. The computer with peripherals has been delivered to the Engineer School at Fort Belvoir, VA for their use in training officers in ADP procedures.

A typical example of the use of the Minicomputer at Group Level is the Project: "Rehabilitation of Building 1596, Herzo Base." Appendix D is a copy of the Completion Report. Appendix E is a copy of "Evaluation of Mini-Computer Project 113-EC-71-24B Herzo Base." Appendix F is a typical Tabulation Run of the project as produced by the computer. Appendix G is a typical Bar Chart as produced by the computer. An example of a typical "Weekly Construction Progress Report" is included in Appendix H.

DISCUSSION

The evaluators mention several times the use of equipment from three different manufacturers and also the fragility of the equipment. These are factors to be considered but they should be coupled with cost when it is time to make decisions. The principal objective of the evaluation was to determine the suitability of commercial computer equipment in the Engineer Construction Battalion operational environment. A preliminary study established what was agreed to be the most cost-effective system available with a target of $25,000 strongly influencing the choice. If, from the evaluation, the user determines that computers at battalion or group level are in fact warranted, it will then be necessary to trade-off the increased cost of more durable components and single-manufactured systems vs. the savings in time and maintenance costs. The requirements for rugged equipment to use in an operational environment generally drive the Army to develop its own military hardware, but in this case it appears as if the environment, at least at group level, could be made less demanding and thereby preclude the Army from developing its own general purpose computer.

Service contracts were provided for the T. I. Silent 700 Data Terminal at Frankfurt and for the Data General Nova at Munich. It should be taken into consideration that both services are somewhat removed from the 24th Group Headquarters at Kaiserslautern and even more remote from the 293rd Battalion Headquarters at Baumholder. This accounts for delays in repairs.

The equipment had a total of about 1600 hours running time at the conclusion of the evaluation.

CONCLUSIONS

1. The Minicomputer provides a needed capability to Engineer construction groups.

2. The usefulness at Battalion level is questionable but the evaluation was not conclusive when the task had to be terminated.

3. Commercial grade equipment would probably be satisfactory under the controlled environment generally available at the Engineer Group level.

4. A Central Processor should have about 32K Core memory.

5. The use of paper tape seems to be marginal.

6. The data terminal should have a printout capability of about 100 characters a second as well as multiple-copy ability.

APPENDIX A

REPORT OF LIMITED ENVIRONMENTAL TESTS

DEPARTMENT OF THE ARMY Mr. Pierce/ets/870-3535
ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND 21005

STEAP-MT-I

10 OCT 1972

SUBJECT: Final Letter Report of Environmental Test of Minicomputer (TECMAT), TECOM Project No. 6-ES-415-NMS-001, Report No. APG-MT-4174

Commanding Officer
U. S. Army Land Warfare Laboratory
ATTN: RDLW-TS
Aberdeen Proving Ground, Maryland 21005

1. References:

a. Letter, RDLW-TS, 20 April 1972, subject: Minicomputers (TECMAT), LWL Task 50-E-71, AMCMS No. 563A000.

b. Letter, AMSTE-EL, 2 May 1972, subject; Customer Test Directive, Minicomputer (TECMAT), TECOM Project No. 6-ES-415-NMS-001 (Environmental Test).

c. Letter, RDLW-TS, 18 September 1972, subject; Minicomputers (TECMAT), LWL Task 50-E-71, AMCMS No. 563A000.

2. Background:

The U. S. Army Land Warfare Laboratory (USALWL) is evaluating a Minicomputer System to determine the suitability of the components for military use.

The Minicomputer System consists of a 30 character-per-second typewriter-printer, a tape-deck for magnetic tape input, a punched-paper tape reader, and a central processing unit which includes two 8K memory units (utilizing Fortran language), a power monitor, and an automatic program loader. All components of the system, except the typewriter-printer, are mounted in a cabinet approximately 2 x 2 x 3 feet in size. A wood transport case is provided for shipping the cabinet. The typewriter-printer is provided in a separate small carrying case. The system operates from a 120 volt, 60 cycle power source. The power requirement is approximately 600 watts.

STEAP-MT-I 10 OCT 1972

SUBJECT: Final Letter Report of Environmental Test of Minicomputer (TECMAT), TECOM Project No. 6-ES-415-NMS-001, Report No. APG-MT-4174

USALWL requested that environmental tests be conducted on the test item according to the procedures provided in references 1a and 1c.

Reference 1b assigned the test to the Materiel Testing Directorate of Aberdeen Proving Ground. The testing was conducted from 7 August to 8 September 1972 by the Electronic and Fire Control Branch, Infantry Materiel Division.

3. Objective:

The objective of this test was to conduct environmental tests on the test item and provide the results to USALWL.

4. Summary of Results:

a. Operation - An operational test of the test item was provided by using diagnostic programs which were on magnetic tape supplied by USALWL. These programs were designed to indicate any malfunction in the operation of the system. The system was given an operational test at room temperature (25°C) using commercial 120-volt power. It was also tested using power from a 5 kilowatt military generator while the generator had the following loads: Computer only (600 watts), half-rated load (including computer) (600 + 1900 watts), and full-rated load (including computer) (600 + 4400 watts). The loads were heating-element strips that were connected to the output of the generator.

The test item operated properly while using any of the above loads and also while switching from one size load to another. The system also operated properly while utilizing various types of data inputs, such as magnetic tape, punched-paper tape, and typewriter input.

b. Altitude - The test item was stored at a simulated 40,000 feet altitude at +25°C for 4 hours in accordance with Method 500, MIL-STD-810B (storage portion only). After the exposure, the item performed the operational test satisfactorily and no damage occurred.

c. Humidity - The test item was subjected to one cycle (48 hours) of a humid environment according to Procedure II, Method 507, MIL-STD-810B with a maximum temperature of +50°C with 90 percent relative humidity. An operational test with varying generator loads was performed during a portion of the cycle at +30°C. The test item operated satisfactorily and no damage occurred.

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SUBJECT: Final Letter Report of Environmental Test of Minicomputer (TECMAT), TECOM Project No. 6-ES-415-NMS-001, Report No. APG-MT-4174

d. High Temperature - In accordance with Method 501, MIL-STD-810B, the test item was stored at +50°C for 24 hours. Then an operational test was performed at +50°C using data previously stored in the computer memory. Generator loads were varied during the test. Due to a restricted operating temperature range (by USALWL) of +7°C to +32°C for using the magnetic tape, the item was then operated at +32°C using the magnetic tape input. The test item operated satisfactorily and no damage occurred.

e. Low Temperature - In accordance with Method 502, MIL-STD-810B, the test item was stored at -30°C for 24 hours. Then an operational test was performed at 0°C and +7°C using data previously stored in the computer memory. Generator loads were varied during the test. The system operated satisfactorily with the stored data at 0°C and +7°C and no damage occurred.

Then an attempt was made to operate the system at +7°C with the magnetic tape, but the system would not accept any data input. Returning the system to +21°C did not correct the problem. Repairing a loose typewriter-cable connection did not correct the problem either. The tape-deck was returned to the factory where a loose integrated-circuit connection was found and repaired.

The test at +7°C was then repeated and again the system would not accept any data input from the magnetic tape. At +21°C, the system responded intermittently. Contractor personnel inspected and tested the system, and came to the conclusion that there was excessive vibration in the motors of the tape-deck.

The tape-deck was replaced.

The system was again tested at +7°C and still would not accept data input from the magnetic tape. However, at +21°C, the system operated properly. After lowering the temperature of the system slowly in small increments, it was found that the system would not accept any data input from the magnetic tape below a temperature of +13°C. Raising and lowering the temperature of the test item several times confirmed this fact.

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The system operated satisfactorily after returning to +25°C. However, on the following day, the central processing unit failed to operate properly at +25°C. The unit was returned to the factory and inspected. Contractor personnel found an integrated-circuit that had failed and it was replaced. USALWL then decided to stop the environmental testing and considered the project completed.

5. Conclusions:

Not applicable.

6. Recommendations:

Not applicable.

FOR THE COMMANDER:

JAMES C. WHITE
Acting Chief
Infantry Materiel Division
Materiel Testing Directorate

3 Incl
1. Ltr, AMSTE-EL, 2 May 72
2. Ltr, RDLW-TS, 20 Apr 72
3. Ltr, RDLW-TS, 18 Sep 72

CF:
CG, TECOM, AMSTE-EL (2 cys)

DEPARTMENT OF THE ARMY MAJ Fields/as/4171
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-EL
6-ES-415-NMS-001

2 MAY 1972

SUBJECT: Customer Test Directive, Minicomputer (TECMAT), TECOM Project No. 6-ES-415-NMS-001 (Environmental Test)

Commanding Officer
Aberdeen Proving Ground
Aberdeen Proving Ground, Maryland 21005

1. Reference is made to letter, RDLW-TS, USALWL, dated 20 April 1972, subject: Minicomputers (TECMAT), LWL Task 50-E-71, AMCMS No. 563A000 w/incl (Incl 1).

2. Environmental testing described in referenced letter is assigned your agency. TECOM project number 6-ES-415-NMS-001 has been assigned. TECOM priority code 3 applies. TRMS forms are attached (Incl 2).

3. Prepare and submit a man-hour and cost estimate in accordance with TECOM Regulation 70-33 and paragraph 4 of inclosure 1.

4. Direct coordination with customer is authorized concerning details of the effort (paragraph 5, inclosure 1). Point of contact at this headquarters is MAJ James E. Fields, ext. 4171.

5. Special Instructions: Testing will be accomplished in accordance with test outline provided by customer (Incl 1 to Incl 1). One copy of final letter report will be forwarded to this headquarters.

FOR THE COMMANDER:

Frances T Smith
FRANCES T SMITH
Asst Admin Officer

2 Incl
as

Copy furnished:
CO USALWL ATTN: RDLW-TS

DEPARTMENT OF THE ARMY
U. S. ARMY LAND WARFARE LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21005

RDLW-TS

20 APR 1972

SUBJECT: Minicomputers (TECMAT), LWL Task 50-E-71, AMCMS No. 563A000

Commanding General
U.S. Army Test & Evaluation Command
ATTN: AMSTE-TO-O
Aberdeen Proving Ground, Maryland 21005

1. Reference is made to discussion between Messrs. T.E. Burke and C.G. Moler, Electronic and General Equipment Division, MTD, and Messrs. J.P. Francis and D.C. Adams, LWL, on 23 May 71.

2. The U. S. Army Land Warfare Laboratory in conjunction with CDC is evaluating a Nova Minicomputer System to determine the suitability of the components for military use.

3. It is requested that Environmental Tests be conducted on the Minicomputer as outlined in Inclosure 1. If your Command determines that any additional testing would add to the evaluation of the subject item, this Laboratory should be notified. Request authorization for direct contact between the testing agency and USALWL.

4. In order that funds may be transferred, a cost estimate should be forwarded to this Laboratory.

5. Technical information can be obtained by contacting Mr. J.P. Francis, Task Officer, LWL, ext. 2920. For other information, contact Mr. D.C. Adams, Test Liaison Officer, LWL, ext. 3370.

FOR THE COMMANDER:

PETER B. FERRARA
Chief, Technical Support Division

1 Incl
Test Outline

TEST OUTLINE

I. DESCRIPTION:

The Nova Minicomputer System consists of the following components, peripheral equipment and software:

MODEL	DESCRIPTION
8134	Data General Nova 1210 Computer
8174	Data General 8K Memory (2 each)
8106	Data General Power Monitor/Auto, Restart
8108	Data General Auto Program Load
8122	Data General Cable Connector
4707	Data General 1/0 Sub-Assembly Syner-Data Tape ASR 1/0 Interface
Total Term	Syner-Data 30 Character/Sec., and Keyboard and Printer, Type ASR
C0600PN	Computer Operations Linc Tape
C0600PN	Computer Operations Linc Control
C0610	Computer Operations Power Supply

Table top cabinet for Data General and Linc components with interconnecting wiring and cables.

(6) Extra Linc Magnetic Tapes
(6) Rolls of Paper for Syner-Data

Program tapes for Data General, Linc, Syner-Data (ASR) will be provided by the contractor and will be for utility programs consisting of diagnostics, basic, and advanced Fortran.

The system will operate from a utility 10KW, 120 Volt, 60 Cycle single phase engine generator set. The Minicomputer shall require no more than 1800 watts primary power. In addition, a suitable transport container will be provided.

II. OBJECTIVE:

The objectives of the test are to determine the suitability of the components for military use. The system must withstand the non operate (storage and transport) environmental conditions listed as well as the operational environmental atmosphere. During the operational test, the system will operate from a utility generator, the output of which will be subjected to varying load conditions similar to those encountered in the field.

III. TEST OUTLINE:

A. A software program which will exercise various functions of the computer system will be provided by the Engineer School for use during the tests. The program will be run during the operational tests and after the nonoperational tests. A test program will be provided by the manufacturer to be used to check out proper operation of all the functions of the computer as required.

B. Non-operational (storage and transport) tests:

(1) Temperature: -30°C to +60°C (MIL STD 810B Method 501-502),
(2) Altitude: 40,000 ft (MIL STD 810B Method 500),
(3) Vibration and shock in transport case (MIL STD 810B Method 514).

C. Operational tests:

(1) Temperature: 0°C to +50°C (MIL STD 810B Method 501-502),
(2) Humidity: 90% (MIL STD 810B Method 501-502 Procedure I),
(3) Operational tests C(1) and C(2) shall be conducted with the computer operating from the 10KW utility generator with the following loads cycles:

(a) Computer only,
(b) Computer and 1/2 rated load,
(c) Computer and full rated load (total).

(4) Diagnostic programs shall be used to determine satisfactory computer operation during C(3) tests.

IV. CLASSIFICATION:

Unclassified.

V. SAFETY PRECAUTIONS:

Normal to environmental testing.

VI. AVAILABILITY:

15 Jun 72.

VII. REPORTING:

Letter Report, 10 copies to be forwarded to USALWL, ATTN: RDLW-TS.

DEPARTMENT OF THE ARMY
U. S. ARMY LAND WARFARE LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21005

RDLW-TS

18 SEP 1972

SUBJECT: Minicomputers (TECMAT), LWL Task 50-E-71, AMCMS No. 563A000

Commanding General
U. S. Army Test and Evaluation Command
ATTN: AMSTE-EL
Aberdeen Proving Ground, Maryland 21005

1. Reference: Letter, RDLW-TS, USALWL, 20 Apr 72, Subject as above.

2. Request the following modifications to Item III of the Test Outline submitted as Inclosure 1 to the above reference:

a. Paragraph B(1) - Change high storage temperature from +60° C to +50°C.

b. Paragraph B(3) - Delete vibration and shock in transport case.

c. Paragraph C(2) - Change humidity test to read one (1) cycle.

d. Paragraph C(3) - Change to show computer operating from a 5 KW utility generator instead of 10 KW.

3. This letter confirms verbal changes authorized by USALWL Task Officer during tests.

FOR THE COMMANDER:

Charles W. Lowery

CHARLES W. LOWERY
Acting Chief, Technical Support Division

ABSTRACT

An environmental test of the Minicomputer (TECMAT) was conducted by the Materiel Testing Directorate at Aberdeen Proving Ground from 7 August to 8 September 1972. Environmental facilities and personnel support were provided to conduct the environmental tests requested by U. S. Army Land Warfare Laboratory (USALWL). The test item operated satisfactorily after exposure to a humid environment and to a simulated high-altitude. It also operated satisfactorily at room temperature and during exposure to high temperature. During exposure to low temperature, the central processing unit operated satisfactorily, but difficulty with data transfer was encountered when operating the tape-deck with the magnetic tape. The difficulty was traced to failure of some integrated-circuit connections and excessive vibration in the motors of the tape-deck. During testing it was found that the system would not accept any data input from the magnetic tape when operating below a temperature of +13°C. At the end of the testing the results of the project were provided to USALWL.

APPENDIX B

EVALUATION PLAN FOR MINICOMPUTER

D R A F T

EVALUATION PLAN FOR MINICOMPUTER

1. REFERENCES:

a. DA Letter, DACS-CMO, 10 Nov 71, Test and Evaluation.

b. DA Letter, CSGEN-S, 18 Sep 70, Test and Evaluation of Commercial Minicomputer.

2. INTRODUCTION:

The Minicomputer is a small off-the-shelf digital computer. It is to be evaluated for suitability of the Minicomputer concept for use by Engineer Battalion Group and Command and to determine if commercial hardware is adequate for use by these units.

3. BACKGROUND:

CDC requested USALWL to procure as part of the TECMAT Program and conduct an evaluation of the Minicomputer in close coordination with the USA Engineer School. The Engineer School suggested an appropriate computer and peripheral equipment. After obtaining DA approval, USALWL purchased the system and is conducting the evaluation with the close cooperation of the USAES. Limited environmental tests have been conducted

4. DESCRIPTION:

The Minicomputer consists of a Nova 1210 central processor with 16K integrated circuit memory. It includes automatic program load and automatic power failure restart. The peripherals include a LINC magnetic tape system, a Texas Instrument Silent 700 terminal and a REMEX paper tape reader. The Nova, LINC and the REMEX are mounted in a cabinet together with the appropriate interconnecting cables. A running time meter is also included. The computer

ready to run weighs about 200 lbs. The Silent 700 data terminal is mounted in a separate carrying case similar to a portable typewriter. The terminal weighs about 40 lbs.

5. PURPOSES:

a. To determine the suitability of commercial computer equipment in the Engineer construction battalion operational environment.

b. To determine the quantity of Engineer computer applications in Engineer construction units, both group and battalion.

c. To solicit computer applications and requirements from the Engineer Command structure.

d. To determine the suitability of the computer with those applications identified in paragraph 5c above.

6. SCOPE:

a. The field evaluation will start about 1 October 1972 and will be of one year duration. It will be conducted in designated units of the US Army Engineer Command, Europe. The Group application will be implemented by the 24th Engineer Group. Available software will include hardware diagnostic routine provided by the manufacturer, Basic interpreter, a Fortran IV compiler and modified disc operation system permitting I/O to the magnetic tape drives. Initial application programs will include engineer management, civil engineering, and topography. A family of barrier planning programs will become available during FY73 and will be integrated into the evaluation.

b. The computer system will be accompanied to the 24th Engineer Group by the USALWL Task Officer and the USAES representative who will set up,

check-out and introduce the equipment to the users for a period of 2-3 weeks. A test officer trained at the USA Engineer School will be on PCS for the entire time of the evaluation. The test officer is familiar with the test plan, existing software, Basic and Fortran IV, and will be qualified to operate the system and perform limited troubleshooting and repair of hardware. The test officer will maintain a log (Annex 2) to account for all system usage to include utilization of peripheral components.

c. Applications nominated by test units will be programmed and implemented in the field when possible. Where this is not possible, an analysis of the application, outputs desired and inputs available will be carefully documented and sent to: Commandant, U. S. Army Engineer School, Department of Engineering Science, ATTN: Engineering Management Division, Fort Belvoir, Virginia 22060, for programming, debugging and return to the test location.

d. The computer system shall be operated for a period of 80 hours from a utility field generator of no less than 5 KW rating (110V 60 cycles). Tests at USALWL have indicated that the operation on the utility generator will be satisfactory.

7. PROCEDURE:

The engineer management software package will have top priority for computer usage. A master file will be maintained for each construction project chosen for the evaluation and reports, schedule, and tabulation sheets will be produced as required by the test officer. Problems encountered using the engineer management package as related to:

a. Input requirement

b. Output requirement

c. Turn around

d. Personnel

e. Hardware reliability

f. Software logic

will be recorded and reported monthly through USALWL to the USAES. The test officer will log (Annex 2) each use of the machine in his log books and will make estimates of the manhours required to do the same job without the use of the computer. Production, familiarization and debugging runs will each be identified in the log books. Other engineering applications may be run with the computer on a time available basis. The test officer will conduct briefings and familiarization training of operating personnel as necessary. Procedures for production use of the engineer management package will be documented and altered as necessary. See Annex 1 for Detailed Software Plan.

g. Location: The computer shall be located at Battalion level for a period of not less than six months. The computer may be located initially at Group level if desired. Upon movement of the computer the test officer will notify USALWL and USAES.

h. Maintenance: Routine maintenance such as replacement of fuses, cleaning of tapes and heads, etc. shall be conducted by the test officer who will note same in log book. Maintenance for the TI Data Terminal will be provided by the TI Office in Frankfort. The Data General representative in Munich will provide maintenance for the Nova and the LINC tape equipment.

8. SUPPORT REQUIREMENTS:

a. Floor space of not less than 100 square feet shall be provided. A table to accommodate the computer is required. An office desk and chairs are also needed. One file cabinet for program tapes and material.

b. Electrical power (either 1 or 2).

(1) 220 volts 50 cycles 10 amps from wall receptacle.

(2) 110 volts 60 cycles 15 amps from a utility generator of at least a 5 KW rating.

c. Transportation of the computer as required.

d. Storage space for reusable shipping boxes.

e. Utility field generator of 5 KW rating or greater 110 volts at 60 cycles.

9. SAFETY: Waiver of safety statement has been applied for.

10. REPORTING PROCEDURE:

A copy of both logs shall be forwarded to USALWL, APG, Md. 21005 NLT 10th of each month together with the monthly report. Original log books shall be maintained until the conclusion of the evaluation and then will be picked up by task officer. In addition, the following records shall be maintained: documentation of each application and/or program, recommendations of test officer, and recommendations of the users.

11. Disposition of equipment shall be determined at conclusion of evaluation in accordance with CDC-LWL TECMAT agreement.

ANNEX 1

MINICOMPUTER SOFTWARE EVALUATION PLAN

1. The software development, testing and support for OCONUS test of the minicomputer will be the responsibility of the Department of Engineering Science, US Army Engineer School, Ft. Belvoir.

2. The purpose of the software evaluation is twofold. (1) to generate the information which will aid Engineer Agency CDC to develop the general functional systems requirements for engineer field use of computer and (2) to evaluate the currently available engineer software in a field environment. These purposes will be accomplished by eliciting suggestions from field commanders and conducting experiments by providing trial programs to them during the test and recording their responses. This will be the joint responsibility of the test officer and the USAES.

3. The software is roughly divided into three types. (1) the LINC tape operating system (LTOS), (2) the non-LTOS data file management package and (3) the Engineer applications programs.

4. The LTOS was provided by the vendor (Computer Operations, Incorporated) and shall be considered to include the tape file management programs, FORTRAN oompiler, BASIC interpreter, assembler, binary and relocatable loaders, file editor and symbolic debugger. It also includes two exerciser programs to be utilized in the environmental evaluations.

5. The non-LTOS data file management package was written by USAES and handles file management functions for data files that are to be read or written from FORTRAN programs.

6. The engineer applications programs are written by USAES and are broken down into three parts. (1) the engineer construction management package, (2) engineering design applications and (3) other engineer applications.

7. The engineer construction management package consists of approximately ten separate programs which share the same project master file. Battalion construction projects are stored as CPM networks in the master file. Work schedules based on a logical construction sequence and resource limitations are produced weekly as well as the weekly construction progress report. This package will arrive complete when the computer is installed OCONUS and will receive primary emphasis during the test.

8. Engineer design software is developed and will continue to be developed for use in the evaluation. Some representative applications are: bridge superstructure design, horizontal alignment, vertical alignment, earthwork volume computation, ditch design, culvert design, materials take off and BOM.

9. Other engineer applications include topological survey calculations and several combat engineer packages including barrier planning.

10. There are two log sheets that will be kept on the machine continuously. (1) the daily usage log (Annex 2, Page U) which details the use of the machine for each day, and (2) the maintenance log (Annex 2, Page M) which will record all maintenance activity.

11. Operating SOP's and program writeups will be the responsibility of USAES and will be completed and forwarded to the test unit, USACDC and USALWL as they are available.

12. Training of selected personnel in the test unit to operate the machine will be the responsibility of the test officer and will be conducted in such a manner and at such time as he sees fit.

13. The test officer will forward all daily log sheets and maintenance log sheets along with his written evaluation of the test monthly to USAES, USALWL and USACDC for inclusion in the record. This written evaluation will describe the use of the system and suggestions for hardware and software improvements based on his experience during the reporting period. Comments by field commanders and other test unit personnel will also be included where applicable.

DATE: _____

COMPUTER MAINTENANCE LOG

TIME* F R D	WEATHER TEMP. HUMID.	MALFUNCTION DESCRIPTION OR ROUTINE MAINTENANCE**	PARTS DESCRIPTION	PARTS NUMBER	PARTS PRICE	REPAIRING SKILL NECESSARY	COMMENTS

* INDICATE HERE THE TIME OF THE FAILURE(F), THE REPAIR(R), AND THE DOWNTIME(D).
** INDICATE HEAD CLEANING(H), DIAGNOSTIC TEST (D)

ANNEX 2 - LOG PAGE M

MINICOMPUTER LOG

Monthly Report

TEST OFFICERS COMMENTS:

USERS COMMENTS:

HARDWARE COMMENTS:

SOFTWARE COMMENTS:

MISCELLANEOUS:

ANNEX 2 - LOG PAGE R

DATE: _____ MINICOMPUTER USE LOG TIME ON: ____ OFF: ____

TIME* S	F	E	OPERATOR'S NAME AND RANK	PROGRAM NAME	PROJECT NAME	TYPE RUN**	ORGANIZATIONAL LEVEL FOR WHICH PROGRAM IS USED	COMMENTS***

* INDICATE THE START(S), FINISH(F), AND ELAPSED(E) TIMES

** INDICATE IF THE PROGRAM WAS A PRODUCTION RUN(R), A FAMILIARIZATION RUN(F), A DEMONSTRATION RUN(D), OR A DEVELOPMENT RUN(DEV).

*** PLACE HERE ANY COMMENTS YOU MAY HAVE TO INCLUDE AN ESTIMATE OF TIME TAKEN TO COMPUTE THE SAME OUTPUT BY MANUAL METHODS.

APPENDIX C

EVALUATION REPORT AND FIRST ENDORSEMENT FROM ENGINEER GROUP AND BATTALION

DEPARTMENT OF THE ARMY
Headquarters, 293rd Engineer Battalion
APO New York 09034

AEUEC-XXOP

06 MAR 1974

SUBJECT: Final Report for Mini Computer (LWL Task # 50-E-71)

Commander
24th Engineer Group (Const)
ATTN: AEUEC-XOP
APO 09227

1. Usage: Analysis of daily log records reveals that ninety-five percent of all computer time was spent on CPM development. Of this ninety-five percent, approximately seventy percent of the time was involved in development of project CPM's, and the remaining thirty percent was spent in producing printed copies of CPM's for analysis. The remaining five percent was spent in program development of other applications-surveying, drainage, bridging, etc. The test officer believes these percentages will be representative of any construction battalion in the world, The main problem area in project management is proper job planning and reevaluation of project status, all at which the computer performs excellently.

2. Monitored projects: An analysis of the following projects reveals typical applications of both working days and activities;

a. Ockstadt - Hawk Missile Site.

(1) Site plan - 42 activities, 90 working days.

(2) Radio Communication Building - 165 activities, 156 working days.

(3) Missile Service, Booster, and Generator Bldg - 145 activities, 145 working days.

(4) Sum total of activities for Ockstadt - 352 activities.

b. Katterbach Billet Rehab - 105 activities, 180 working days.

c. Ramstein - Hangar Construction - 60 activities, 195 working days.

d. Grafenwoehr - Main Complex - 196 activities, 266 working days.

e. Grafenwoehr - Range Rehab - 24 activities, 76 working days.

f. Gerthasuen - Billet Rehab - 90 activities, 140 working days.

g. Kleinkotz - Range Repair - 60 activities, 135 working days.

3. Maintenance problems:

a. Breakdowns occurred primarily due to delicate nature of machinery. Future machinery must be adaptable to field use so must be capable of rough treatment within reason.

b. Due to three different manufacturings of machinery, problems were encountered in determining which piece of equipment was truly at fault. Suggest that future computer be of same manufacturing to facilitate troubleshooting.

c. Machinery must be repaired on site. Consideration should be given to utilization of Army personnel to maintain equipment.

4. Overall Evaluation:

a. Machinery. Overall the machinery is not satisfactory. It is too delicate, plus the three different manufacturers make maintenance difficult. Core should be increased to allow for 300 working days and 300 activities. Printout speed should be increased by twice. Smaller items which need improvements are in October 1972 and December 1972 reports.

b. Software. The CPM software was very well adapted to the CPM problems pertinent in Europe. However, bugs must be removed - especially in /BAL. Pertinent comments have been reported in prior reports. Suggest emphasize work on CPM related topics. Problems outside CPM may be developed by the user himself.

c. Effectiveness at Group and Battalion level.

(1) Effectiveness at Group level. An average of 16 projects are worth running at any one time. Average duration of a project is 16 months. We may assume that a turnover of 16 projects is every 4 months. About 3 hours on the computer will save 30 hours spent in hand calculation in initial stages. About 4 hours of a lieutenant's time is spent preparing a WCPR each week. This same work takes 15 minutes on the computer. 50 weeks per year are spent in construction.

(a) Weekly hourly savings over a 5-year span of a machine: (4-.25) x 16 x 50 x 5 = 15,000 hrs.

(b) Initial CPM saving over 5-years: 3 x 16 x (30-3) x 5 = 6,500 hrs.

(2) Effectiveness at battalion level. Since battalion level only generates 4 projects worth monitoring, the Group level figures should reduce by 75 percent.

5. Discussion. These cost and saving figures are the only ones that can be justified at the moment based on facts. Although project officers qualitively rate the output as "tremendous" and "effective" such abstract evaluation cannot be determined in dollar savings. Their evaluations are based primarily on the extended capabilities offered by computer output. (See extended capabilities offered by computer) These saving figures have several surprising implications:

a. A definite savings can be proven at Group level in construction management, providing all projects adaptable to computer monitoring throughout the Group will be put on the machine. Observation and discussion at Group reveals that roughly 32 projects are going at any single time, with about 50% of that number adaptable to computer monitoring and the remaining 50% not adaptable (See Projects Not Adaptable to Computer Monitoring).

b. Since a battalion has an average of 10 active projects on one time, of which 4 would be adaptable to computer monitoring, saving would appear to be difficult to prove at battalion level, simply because the battalion would have 4 projects at a time as compared with 16 at Group level.

c. One important item, though, has not been determined - can the presence of float times and the critical path be effectively used by the project officer to allocate his resources to result in a decrease in the duration of the project, thus saving money ??? So far, Herzo Base has definitely used the float times to its advantage, thus reducing the project duration, only to have the duration lengthened again by material shortages - thus the net gain is zero and no saving can yet be proved. Would this imply that other areas in the construction house are inefficient to the degree that their inefficiency will override many beneficial effects the computerized version offers ???

6. Extend Capabilities Offered by Computer Construction Management.

a. Permit CPTS diagrams (in bar chart form) to be created quickly in the project pre-construction phase based on only a hand-drawn CPM network, thus saving effort that could be allocated profitably elsewhere. Quick production time encourages CPM analysis and change.

b. Performs a resource balance previously done by hand.

c. Predicts an accurate resource total, thus suggesting manpower, requirements necessary to forecast TDY requirements.

d. Presence of interfering float, free float, and critical path, which allows the project officer on any day to determine the importance of one activity relative to another.

e. Weekly updated CPM printouts that show the project status. The result of project delays are accurately reflected in this weekly printout. This update will allow the project officer the ability to manage his resources and modify his plans accordingly to meet the EDC.

7. Considerations.

a. Accurate manpower and duration estimates are vital for successful estimations of each activity. The number of manhours expended on each activity must be recorded and available for use in future projects.

b. Since accurate manpower and duration estimates are not always present the effect of such inaccuratées can be minimized by the presence of float time introduced by concurrently conducted activities. Numerous simultaneous activities will allow the project officer to wisely allocate manpower according to the importance of activities.

c. User must be trained in the use of the computerized version of CPM, IF and FF must be clearly understood, plus weekly reporting procedures.

8. Projects not adaptable fo Computer Monitoring. Projects not adaptable to computer monitoring falls into two large categories:

a. Projects of short duration (4 - 5 days) and/or of few activities. These type projects could be monitored much easier and more cost effectively by the project officer performing a mental CPM analysis than by a computer doing the same analysis. The CPTS of the building demolition at Goeblingen Kaserne is typical of these short, simple projects.

b. Projects which contaáns practically nothing but critical activities. On a project of this nature the project officer needs no computer to tell him that if he delays an activity that the activities following will be delayed. Obviously the monitoring of this type project would not be profitable.

9. The enclosed annexes contain information pertinent to revealing how the machinery was received:

ANNEX A: Letter from 79th Engineer Battalion (Const) requesting computer for battalion test.

ANNEX B: Completion Report, Herzo Base, discussing how project has been aided by computer.

ANNEX C: Final report on value of computer to project officer of Herzo Base.

ANNEX D: Evaluation of computer by project officers actively associated with computer monitoring.

ANNEX E: ADP SOP that 24th Engineer Group (Const) wishes to follow should ADP be incorporated.

AEUEC-XXOP
SUBJECT: Final Report for Mini Computer (LWL Task #50-E-71)

ANNEX F: Copies of news release.

ANNEX G: Debts which need to be paid to Texas Instrument for repairs made.

FOR THE COMMANDER:

ORIGINAL SIGNED BY
DENNIS C. PIPER
1LT, CE
Adjutant

AEUEC-XOP (22 Apr 74) 1st Ind
SUBJECT: Final Report for Mini-Computer (LWL Task #50-E-71)

DA, Headquarters, 24th Engineer Group (Const), APO 09227 15 MAY 1974

TO: Commander, USALWL, ATTN: Mr. John Francis, Aberdeen Proving Grounds, Maryland 21005

1. Forwarded are final test results for the mini computer NOVA 1200, conducted within the 24th Engineer Group (Const) during the period November 1972 to 1 April 1974.

2. The test was conducted in two phases. During the first phase, November 1972 to June 1973, the computer was located at Group Headquarters in Kaiserslautern, Germany and from there serviced four battalions. During the second phase, July 1973 to 1 April 1974, it was relocated to Baumholder, Germany and serviced primarily those projects undertaken by the 293rd Engineer Battalion (Const).

3. Throughout the test period the use of the computer was limited to the development and applications of management data for construction project task schedules.

4. The test revealed that Automatic Data Processing within a Construction Engineer Group is a very worthwhile capability, which results in a substantial reduction of time in accomplishing mission essential requirements. The extent of this capability is greater at the Group level than at the battalion level.

a. The Group should be authorized a machine with memory capacity of 30-36K in order to service four battalions. The computer should be tailored to satisfy the following applications:

(1) Perform construction management operations such as network analysis (CPM) for approximately 150 projects annually. This would include weekly updates of each project as well as resource allocations of personnel and equipment.

(2) Perform trigonometric computations such as closures of traverses and earthwork computations for cut and fill operations.

(3) Perform logistical tabulations to include status of equipment by model number, serial number and manufacturer for approximately 2300 major end items of equipment.

(4) Support combat engineer missions in accordance with established contingency plans.

b. At the battalion level it is envisioned that a programmable desk calculator with the following applications is needed:

(1) Trigonometric computation for survey and design.

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SUBJECT: Final Report for Mini-Computer (LWL Task #50-E-71)

(2) Network analysis (CPM).

5. In accordance with your request, programs and tape runs used during the test were forwarded via air, on 3 May 74. The computer has been shipped through the Rail Transportation office, 7 May 74.

FOR THE COMMANDER:

JOSEPH A. TREVINO
CPT, AGC
Adjutant

APPENDIX D

COMPLETION REPORT OF PROJECT "REHABILITATION OF BUILDING 1596, HERZO BASE"

COPY

DEPARTMENT OF THE ARMY
COMPANY C, 79TH ENGINEER BATTALION
APO N.Y. Ø936Ø

AEUEC-XUX 19 Mar 73

SUBJECT: Herzo Base Completion Report, Project 113-EC-71-24B, Rehab of Bldg 1596

Commander
79th Engr Bn
ATTN: AEUEC-XUOP
APO Ø936Ø

1. The following items are inclosed:

a. Completion letter with Inclosure (Incl 1).

b. Pictorial coverage (Incl 2).

2. Unusual problems encountered and solutions:

a. Administrative: Management of this project was greatly aided by utilization of the CPM program on the 24th Engineer Group's Mini Computer. No unusual problems were encountered in project administration.

b. Supplies and materials: Several times the unit was complemented by the Group on its supply and material storage facilities. A continuous effort resulted in no materials problem whatsoever.

3. No significantly unusual engineering techniques were used on this project. Rehabilitation work consisted of basic masonary, carpentry, plumbing techniques. The care taken in applying these techniques resulted in a truly superior finished product.

4. Conclusions and recommendations have been completed from the weekly lessons learned.

a. OBSERVATION: On projects where the design and BOM are made by Battalion staffs, many specifications for locally procurred items vary from the German DIM.

SUBJECT: Herzo Base Completion Report, Project 113-EC-71-24B, Rehab of Bldg 1596

EVALUATION: Where BOM specifications vary from the German DIM, invariably, unnecessarily long procurement times and higher costs result from custom fabrication by German firms.

RECOMMENDATION: Every effort should be made to refer to the German DIM when specifying construction materials, such as toilets, doors, pipe, etc.

b. OBSERVATION: The amount of sand required to sand hangar doors to bare metal is significantly more than that on the original BOM. A check with Facility Engineers, Nurnberg, revealed original estimate was based on rough sanding only selected areas of the doors. A check with the District Engineers, Nurnberg, indicated that the doors were to be sanded to bare metal, primed, and painted.

EVALUATION: Again this should have been brought up at or before the preconstruction conference. Items such as this oftentimes are overlooked. Apparently it was not explicitly stated by the design section to the estimating section exactly the type of sand blasting required.

RECOMMENDATION: Suggest design sections take note of this as well as Battalion, and Group S-3 sections for further project planning.

c. OBSERVATION: The new "mini computer" at Group Headquarters has been and will continue to be a tremendous management tool for construction projects. After digesting the data for a particular weeks construction effort, material delays, and time and resources available for remaining work, the computer pointed the critical activities for the next week. It was thought that sand blasting was critical for a particular week, but it turned out that patching hangar doors was the critical activity for that week. In fact, it had to be finished by COB Friday to remain on schedule.

EVALUATION: The output of the computer is obviously as good as its input. Platoon leaders must be honest; but with good input, the results can be applied to justification for changes in work emphasis, pressuring for particular materials, manpower or equipment shortages.

RECOMMENDATION: Further observation is necessary to establish the full potential of the "mini computer" as a management tool. The biggest problem to date is communicating with the computer before and after it processes data.

SUBJECT: Herzo Base Completion Report, Project 113-EC-71-24B, Rehab of Bldg 1596

d. OBSERVATIONS: In order to put the CPTS on the computer, the usual Haul Materials "catchall" task must be broken down into smaller tasks and logically tie in to other activities: eg. haul sand, sand blast; haul doors, install doors; haul roofing material, install roof; etc. Whether a CPTS is on the computer or not, these short hauling tasks should be placed on the CPTS. They lead logically to a materials delivery schedule.

EVALUATION: The CPTS with the individual haul materials tasks serving as a materials delivery schedule, should be furnished to the Fac Engineer or District Engineer supplying materials. This schedule would establish a more professional relationship between supplier and construction unit.

RECOMMENDATION: Suggest all future project CPTS reflect this materials delivery schedule and be submitted after approval to Facilities Engineer supplier.

e. OBSERVATION: On numerous projects there is always a shortage of small materials such as plumbing and electrical fittings, brick, cement, etc.

EVALUATION: The shortage of small fittings is a direct result of one man making up the BOM and a different man doing the construction with no detailed plan tieing the two men's thoughts together. On several projects, there have been materials for which no use could be found. The result of all this inadequate communication is delay of construction and cost overrun. Better understanding between designer, materials scheduler, and constructor is mandatory to promote harmony and efficiency in future work. In addition, more detailed plans and specifications on all projects would better enable the estimator and craftsman to understand what materials were required and why certain items were ordered.

RECOMMENDATION: Either the construction plans must show exactly where each specific item is to be installed, or the estimators, prior to the preconstruction conference, should discuss each phase of the project with the construction unit at a pre-construction technical conference. Further, more detailed plans should be provided for better understanding during all phases of the project.

f. OBSERVATION: For two weeks with no officer on site, the 2nd construction platoon functioned extremely well, and completed all administrative requirements pertaining to the construction mission.

SUBJECT: Herzo Base Completion Report, Project 113-EC-71-24B, Rehab of Bldg 1596

f. (Cont'd) EVALUATION: The platoon ran smoothly in the platoon leader's absence because the platoon sergeant and the squad leaders were intimately familiar with the scope of work, and understood well how to read the CPTS from the computer and how to report back to it.

RECOMMENDATION: Weekly classes as well as an initial involvement in the planning should be given to all NCO's on developing the CPTS and using it as a management tool on the job site.

g. OBSERVATION: Specific tasks require special tools. E. G. Special trowles for plastering; tile cutters for cutting tile, etc. These tools must be on hand when they are needed to prevent construction delays.

EVALUATION: Consultation with construction experts, TM's, and civilian manuals as well as Facilities Engineers should shed light on types of tools required to complete tasks. Consultation with other project officers, staff officers, and Commanding Officers is also helpful.

RECOMMENDATION: Each project officer should mentally evaluate the tool requirements for each task when he plans a project. He should compare his notes with his platoon Sergeant, Commanding Officer, and staff officers. Then he should consult the Facilities Engineers for availability of non TOE tools. The last step is to go through the chain of command to purchase these tools. Never wait until the lase minute and purchase them out of your own pocket!

h. OBSERVATION: Planning a four-day work week for construction projects in U.S. Army Europe is most realistic and practical.

EVALUATION: A troop construction unit is saddled with more requirements than civilian contractors. Clearly, one full day or 7 hours of construction time per soldier is lost each week for the following reasons:

(1) Administration of military justice.

(2) Sick call.

(3) Organized athletics.

(4) Command information class.

SUBJECT: Herzo Base Completion Report, Project 113-EC-71-24B, Rehab of Bldg 1596

h. (Cont'd) EVALUATION

(5) Formations.

(6) Finance appointments.

(7) Personnel testing requirements.

(8) Individual counselling.

(9) Appointments w/family housing.

This project has been on schedule for 3 weeks W/a 4 day week.

RECOMMENDATION: All future projects planning should consider using a four day work week.

i. OBSERVATION: A 6 month renovation or major construction project necessitates the use of many non TOE items: scaffolds, buckets, extension cords, shoring material, polyethylene covers, hoses, ladders, etc.

EVALUATION: At the end of each project, all non TOE items must be turned in or taken to the dump. At the beginning of another project, these same items are needed.

RECOMMENDATION: Units be allowed to store none YOE construction equipment and materials in specifically designated areas near its home station.

j. OBSERVATIONS: Installation of a ceramic tile wall requires one of two types of base walls, either a flat, block wall or a rough surface masonary wall. In any case, the walls must be plumb both horizontal and vertical.

EVALUATION: The easiest preparation for ceramic tile wall is concrete block or brick because it's easiest to plumb. Then ceramic tile is applied with common mortar.

RECOMMENDATION: Walls to be tiled with ceramic tile should be constructed out of block or brick. Do not attempt to plaster and then apply glue to plaster.

(Signed)

2 Incl
as

STEVEN G. HONZO
CPT, CE
Commanding

APPENDIX E

EVALUATION OF MINI-COMPUTER FOR PROJECT 113-EC-71-24B, HERZO BASE

DEPARTMENT OF THE ARMY
COMPANY C, 79TH ENGINEER BATTALION
APO N.Y. Ø936Ø

AEUEC-XUX

7 Feb 73

SUBJECT: Evaluation of Mini-Computer Utilization, Project #113-EC-71-24B Herzo Base, FRG

THRU: Commander
Co C, 79th Engr Bn
APO Ø936Ø

Commander
79th Engr Bn
APO Ø936Ø
25 Feb 73

TO: Commander
24th Engr Group
ATTN: LT Umdenstock
APO Ø9227

1. Per a request by LT Umdenstock, the following initial observations concerning the utilization of the mini-computer as a magagement tool in the construction of Project 113-EC-71-24B, Herzo Base, are forwarded for evaluation and utilization as appropriate.

2. Project 113-EC-71-24B, Rehabilitation of Bldg 1596, Herzo Base, was first scheduled on the mini-computer early in October 72. Numerous advantages for using the computer became obvious immediately upon interpreting the first output. The computer quickly adjusted the rapidly changing scope & workload into an accurate and current construction schedule. An initial 4 Dec completion datejustifiably jumped to 19 Dec. Further, additions to the scope of work in Nov necessitated the preparation of an entirely new schedule. A logic network was prepared in little over an hour. (This network is totally logical as compared to the conventional networks, which, hand calculated, are not total logic.) One-half hour later the computer produced the project's new schedule. (Conventional rescheduling methods require more than 1Ø man hours.) Rapid rescheduleing is essential, especially for ongoing projects.

3. The rapidity with which the construction schedule is developed & completed enables the project manager to make adjustments for manpower, equipment, & materials limitations as well as time restrictions, with the currently available software. At both Company Battalion level, each project officer can clearly & accurately illistrate his completion date, and his manpower & equipment requirements, to his commander. In cases where two or more units require the same equipment and/or manpower, the commander can shift resources according to

SUBJECT: Evaluation of Mini-Computer Utilization, Project #113-EC-71-24B Herzo Base, FRG

3. (Cont) his priorities, and in minutes, the computer will tell him and his managers how each project will be affected. The advantages of this computer scheduling during wartime became obvious.

4. On construction sites, Officers and NCO's can now manage their projects with more flexibility. Consider the "old" CPTS where each man had to be accounted for, and managers had little if any feeling for available, free and/or interfering float, let alone how to use it. For the project officer who schedules everyman everyday and encounters an unexpected maintenance problem or large numbers of soldiers on sick call, the new mini-computer schedule clearly displays free & interfering float. Seldom does it employ everyman everyday. It may schedule 22 out of 25 men. Now a manager can utilize his remaining men on tasks that have fallen behind, on crashing critical tasks, on maintenance, or simply give a man a well deserved day off. The Plt SGT at Herzo Base finds it much easier to schedule the next work day and project for the next week with the computers schedules.

5. With the Herzo Base project, the schedule is updated weekly. On each Thursday, the past weeks progress is relayed to the computer. Completed tasks are reported as such unfinished tasks which for an unforseen reason, may require extra time to complete are so noted and fed into the computer. After the computer completes a new schedule, project managers can see, the overall affects of the extra time requirements. Management can change the completion date, or apply extra manpower to a particular task. The project officer and NCOIC definately learn more about management using the computer's output. They now have a greater feel for the tasks' interrelationships. The computers output enables them to exert a greater influence on the course and momentum of the project with, at the same time, complete understanding.

6. A large Percentage of the shortcomings of the mini-computer management system stem from the system's newness. These "bugs" are already being ironed out. Communication to & from the computer will always be difficult. Construction progress reports are phoned into the computer on thursdays. Printed results are mailed out the next day at the German Post Office nearest the construction site. This system could only be improved by placing the computer itself in the Battalion Headquarters. Currently there are certain limitations in the systems soft ware. Eventually, it should be able to initially provide TDY and Equipment construction costs and then account for the expenses weekly. Programs are needed to schedule materials delivery. Resources allotted to each task now number three. This needs to be expanded. Perhaps a bigger machine will be requested. Further, the computer could compare actual progress with scheduled progress and then identify poorly proceeding tasks. Application of the computer to military construction and engineering is limited only by the size and the development of soft ware.

AEUEC-XUX 7 Feb 73

SUBJECT: Evaluation of Mini-Computer Utilization, Project #113-EC-71-24B Herzo Base, FRG

7. Presently, the mini-computer is an asset to the construction manager. The project needs more command emphasis both in the areas of interpetation and utilization of results and in developing new software. A seminar for commanders at Group and Battalion level as well as classes for project officers & Senior NCO's would contribute to the better understanding and utilization of this new management information system.

Michael E. Radbill

MICHAEL E. RADBILL
1LT, CE
Project Officer

APPENDIX F

TYPICAL SCHEDULE FOR PROJECT HERZO BASE IN TABULAR FORM

CP	TL -HD	DUR	ESDT	EFDT	LSDT	LFDT	TF	FF	RESOURCES		
==	======	===	====	====	====	====	==	==	=========		
♦♦	10-> 20	1	20OCT72	20OCT72	20OCT72	20OCT72	0	0	130	0	0
	20-> 35	1	30OCT72	30OCT72	16OCT72	16OCT72	4	0	120	0	0
	20-> 40	4	30OCT72	15OCT72	16OCT72	24OCT72	4	0	304	0	0
	20-> 80	4	30OCT72	15OCT72	6NOV72	13NOV72	12	4	104	0	0
♦♦	20-> 99	5	30OCT72	16OCT72	30OCT72	16OCT72	0	0	102	0	0
	20->120	4	30OCT72	15OCT72	16OCT72	24OCT72	4	4	104	0	0
	20-> 60	5	6OCT72	17OCT72	30OCT72	7NOV72	8	0	104	0	0
	35-> 40	3	8OCT72	15OCT72	17OCT72	24OCT72	4	0	116	0	0
♦♦	20->100	1	16OCT72	16OCT72	16OCT72	16OCT72	0	0	303	0	0
	40->160	4	16OCT72	24OCT72	19NOV72	26NOV72	13	0	503	0	0
	40->240	8	16OCT72	5NOV72	29OCT72	13NOV72	4	0	103	0	0
	40->280	9	16OCT72	6NOV72	20NOV72	10DEC72	14	4	102	0	0
	40->140	2	16OCT72	17OCT72	29OCT72	30OCT72	4	0	106	0	0
	40->440	30	16OCT72	26DEC72	6NOV72	16JAN73	8	8	404	0	0
	20->160	1	17OCT72	17OCT72	26NOV72	26NOV72	15	2	303	0	0
♦♦	100->120	3	17OCT72	24OCT72	17OCT72	24OCT72	0	0	104	0	0
	20->180	1	22OCT72	22OCT72	6NOV72	6NOV72	6	2	303	0	0
	60-> 80	2	22OCT72	24OCT72	12NOV72	13NOV72	9	0	104	0	0
	140->180	3	22OCT72	29OCT72	31OCT72	6NOV72	4	0	102	0	0
	20->300	1	24OCT72	24OCT72	25NOV72	25NOV72	19	8	302	0	
	80-> 84	6	29OCT72	7NOV72	14NOV72	27NOV72	8	0	104	0	0
	80->280	9	29OCT72	14NOV72	20NOV72	10DEC72	10	0	102	0	0
	120->220	3	29OCT72	31OCT72	7NOV72	13NOV72	5	0	103	0	0
♦♦	120->340	9	29OCT72	14NOV72	29OCT72	14NOV72	0	0	103	601	0
	160->200	2	29OCT72	30OCT72	27NOV72	29NOV72	11	0	503	0	0
	180->260	5	30OCT72	7NOV72	7NOV72	19NOV72	4	0	106	0	0
	200->380	9	31OCT72	19NOV72	3DEC72	18DEC72	13	13	103	0	0
	220->300	5	5NOV72	13NOV72	14NOV72	26NOV72	5	0	105	0	0
	240->245	7	6NOV72	20NOV72	14NOV72	28NOV72	4	0	103	0	0
	84-> 85	2	12NOV72	13NOV72	28NOV72	1DEC72	8	0	107	0	0
	260->320	5	12NOV72	20NOV72	20NOV72	27NOV72	4	0	104	0	0
	85-> 88	1	14NOV72	14NOV72	4DEC72	4DEC72	8	0	103	0	0
	300->360	4	14NOV72	21NOV72	27NOV72	4DEC72	5	5	103	0	0
	88-> 98	1	19NOV72	19NOV72	5DEC72	5DEC72	8	0	107	0	0
	280->370	4	19NOV72	26NOV72	11DEC72	18DEC72	10	10	104	0	0
	280->380	2	19NOV72	20NOV72	17DEC72	18DEC72	12	12	104	0	0
♦♦	340->360	8	19NOV72	4DEC72	19NOV72	4DEC72	0	0	103	601	0
	98->380	5	20NOV72	28NOV72	10DEC72	18DEC72	8	8	103	0	0
	320->325	3	21NOV72	26NOV72	3DEC72	4DEC72	4	0	110	601	0
	245->248	2	27NOV72	28NOV72	3DEC72	4DEC72	2	0	107	0	0
	325->328	6	27NOV72	10DEC72	5DEC72	18DEC72	4	0	107	601	0
	248->255	1	3DEC72	3DEC72	5DEC72	5DEC72	2	0	110	0	0
	255->265	1	4DEC72	4DEC72	10DEC72	10DEC72	2	0	108	0	0
	265->380	4	5DEC72	12DEC72	11DEC72	18DEC72	2	2	110	0	0
♦♦	360->380	6	5DEC72	18DEC72	5DEC72	18DEC72	0	0	106	0	0
	328->338	3	11DEC72	17DEC72	19DEC72	26DEC72	4	0	108	601	0
	338->400	2	18DEC72	19DEC72	31DEC72	2JAN73	4	4	112	601	0
♦♦	380->400	5	19DEC72	2JAN73	19DEC72	2JAN73	0	0	105	0	0
♦♦	400->410	1	7JAN73	7JAN73	7JAN73	7JAN73	0	0	117	0	0
♦♦	410->420	5	8JAN73	16JAN73	8JAN73	16JAN73	0	0	302	0	0
♦♦	410->440	5	8JAN73	16JAN73	8JAN73	16JAN73	0	0	105	0	0

APPENDIX G

TYPICAL SCHEDULE FOR PROJECT HERZO BASE IN BAR CHART FORM

		1972 OCT															1972 OCT					NOV											1973 MAR											DEC
		2	3	4	5	6	10	11	12	13	16	17	18	19	20	24	25	26	27	30	31	1	2	3	6	7	8	9	10	13	14	15	16	17	20	21	22	24	27	28	29	30	1
		MON	TUE	WED	THU	FRI	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI
• 10 -> 20	1	MOBIL#1																																									
	30A																																										
20 -> 35	1	GUT BLDG																																									
	20A	X	X	X																																							
																•••••	REMAB 1696-HANGER														•••••												
20 -> 40	4	HAUL MATL																																									
		4C	4C	4C	4C	X	X	X																																			
20 -> 60	5	FORM PADS&PREP FLOOR																																									
		4A	4A	4A	4A	4A	X	X	X	X	X	X	X	X																														
20 -> 80	4	MOBIL#2																																									
		4A	4A	4A	4A	F	F	F	X	X	X	X	X	X	X	X	X																											
• 20 -> 99	(5)	PATCH HANG.DOORS							100›																																			
		2A	2A	2A	2A																																							
20 ->100	1	HAUL SAND																																									
		3C	F	F	F																																						
20 ->300	1	HAUL EXH.SYSTEM																																									
		2C	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	X	X	X	X	X																					
20 ->120	4	SEAL SKYLIGHTS																																									
			4A	4A	4A	4A	F	F																																			
20 ->160	1	HAUL PLUMB.FIXT.																																									
		3C	F	F	F	F	F	F	X	X	X	X	X	X	X	X	X	X	X	X	X	X																					
35 -> 40	3	GUT BLDG																																									
		16A	16A	16A	X	X	X																																				
20 ->180	1	HAUL ROOFING MATL																																									
			3C	F	F	F	F	F	X	X	X																																
40 ->160	4	INST.PLUMB.LINES																																									
						3E	3E	3E	3E	X	X	X	X	X	X	X	X	X	X	X	X	X																					
40 ->240	8	REPL.&REPAIR CEIL.																																									
						3A	3A	3A	3A	3A	3A	3A	3A	3A	X	X	X																										
40 ->280	9	REP.&REPAIR HEAT LIN																																									
						2A	2A	2A	2A	2A	2A	2A	2A	2A	F	F	F	X	X	X	X	X	X	X	X	X	X																
40 ->140	2	REMOVE ROOF RADIO RM																																									
						6A	6A	X	X	X																																		
40 ->440	30	REWIRE BLDG.																																									
						4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	F	F	F	F	F	F	F
•100 ->120	3	SAND BLAST HNGR DOOR																																									
						4A	4A	4A																																				
60 -> 80	2	POUR PADS AND FLRS																																									
								4A	4A	X	X	X	X	X	X	X	X																											
140 ->180	3	REM.&REP.WALL›RAD.RM																																									
									3A	3A	3A	X	X	X																														
80 ->280	9	INSTL WOOD&MT DOORS																																									
										2A	2A	2A	2A	2A	2A	2A	2A	2A	X	X	X	X	X	X	X	X	X															
80 -> 84	6	PLASTER WLS/BLK DOOR																																									
										4A	4A	4A	4A	4A	4A	X	X	X	X	X	X	X	X																				
120 ->220	3	RED LEAD HNGR DOORS																																									
										3A	3A	3A	X	X	X	X	X																										
•120 ->340	9	SAND BLAST SUPER & I																																									
										3A	3A	3A	3A	3A	3A	3A	3A	3A																										
										1F	1F	1F	1F	1F	1F	1F	1F	1F																										
160 ->200	2	INSTL PLUMB FIXT																																									
											3E	3E	X	X	X	X	X	X	X	X	X	X	X	X	X	X																
180 ->260	5	RECONST.ROOF																																									
												6A	6A	6A	6A	6A	X	X	X																							
200 ->380	8	INSTL PART›WALLS																																									
													3A	3A	3A	3A	3A	3A	3A	3A	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F								
220 ->300	5	WEATHER SEAL HNGR DO																																									
													3A	3A	3A	0A	3A	X	X	X	X	X																					
240 ->245	7	PAINT INT.›#1																																									

160 ->200	2	INSTL PLUMB FIXT	
180 ->260	5	RECONST.ROOF	
200 ->380	8	INSTL PART,WALLS	
220 ->300	5	WEATHER SEAL HNGR DO	
240 ->245	7	PAINT INT.,#1	
84 -> 85	2	PLASTER WLS/BLK DOOR	
260 ->320	5	REPL.EXT.GUTS&DONSPT	
85 -> 88	1	PLASTER WLS/BLK DOOR	
300 ->360	4	INSTL EXHAUST SYST	
88 -> 98	1	PLASTER WLS/BLK DOOR	
280 ->370	4	STAIN & VAR DOORS	380,
•340 ->360	8	RED LEAD SUPER	
280 ->380	2	TILE OFF FLOORS	
98 ->380	5	PLASTER WLS/BLK DOOR	
245 ->248	2	PAINT INT.#2	
320 ->325	2	PNT EXT.BLDG#1	
248 ->255	1	PAINT INT.#3	
325 ->328	6	PNT EXT BLDG#4	
255 ->265	1	PAINT INT.#4	
265 ->380	4	PNT.INT.#5	
•360 ->380	6	PAINT HNGR DOORS AND	
328 ->338	3	PNT EXT BLD#3	
•380 ->400	5	PAINT HNGR FLOOR	
338 ->400	2	PNT EXT BLDG#4	
•400 ->410	1	PRE INSPECTION TURNO	
•410 ->440	5	CLEANUP	
•410 ->420	5	HAUL SCRAP	440,

RESOURCE TOTALS ••••••••••••••••••

A••••	30	30	30	30	30	23	19	16	20	20	23	26	26	26	27	25	26	27	24	29	22	28	21	28	18	23	23	23	23	14	14	13	17	17	5	5	17	7	7	7	7	7
C••••	0	9	7	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D••••	0	0	0	0	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0
E••••	0	0	0	0	0	3	3	3	3	3	3	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F••••	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0

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APPENDIX H

TYPICAL "WEEKLY CONSTRUCTION PROGRESS REPORT"

ANNEX B TO REGULATION 415-10
WEEKLY CONSTRUCTION PROGRESS REPORT
(PARTIAL)

(1)	PROJECT NO	70AR72
(2)	%SCH COMPLETE	30.0
(3)	%ACT COMPLETE	28.1
(4)	PROJECT TITLE	HAWK SITE-RCB
(5)	LOCATION	OCKSTADT
(6)	MAN HOURS EXPENDED	3310.0
(7)	CONSTRUCTION UNITS	NA-PLT C -CO 94 -BN
(8)	STARTING DATE	16/ 3/73
(9)	CURRENT EDC	2/11/73
(9A)	DISTRICT PROJECT	NA
(10)	MH SCHEDULED ORIGINAL	11608.0
	MH SCHEDULED CURRENT	11750.0
(11)	REPORT PERIOD ENDING	15/ 6/73

(14) MAJOR TASK MANHOUR DATA

TASK IDENTIFICATION TAIL -> HEAD	SCHEDULED DATA MHRS	%WT	MANHOURS PERIOD US	LS	EXPENDED TO DATE TOTAL		% COMPL
COMPLETED	3259	2808	0	0	1688	0	100
229 -> 233	199	1	22	0	110		46
235 -> 239	0	0	60	0	60		27
239 -> 243	96	0	6	0	6		27
243 -> 245	8	0	8	0	8		50
245 -> 247	384	3	145	0	145		43
248 -> 249	96	0	23	0	185		85
249 -> 255	0	0	8	0	40		55
255 -> 257	32	0	12	0	28		46
285 -> 287	119	1	6	0	222		90
287 -> 301	287	2	80	0	80		17

*** TDY PER DIEM ***

ALLOTTED FUNDS	0.
CONSUMED FUNDS	0.
%TIME COMPLETE	38.0
%TDY.EXPENDED	0.0

ANNEX B TO REGULATION 415-10
WEEKLY CONSTRUCTION PROGRESS REPORT
(PARTIAL)

(1)	PROJECT NO	70AR
(2)	%SCH COMPLETE	71.0
(3)	%ACT COMPLETE	25.6
(4)	PROJECT TITLE	HAWK SITE-SITE
(5)	LOCATION	OCKSTADT
(6)	MAN HOURS EXPENDED	1729.0
(7)	CONSTRUCTION UNITS	NA-PLT C -CO 94 -BN
(8)	STARTING DATE	16/ 3/73
(9)	CURRENT EDC	10/10/73
(9A)	DISTRICT PROJECT	NA
(10)	MH SCHEDULED ORIGINAL	18648.0
	MH SCHEDULED CURRENT	15593.0
(11)	REPORT PERIOD ENDING	18/ 5/73

(14) MAJOR TASK MANHOUR DATA

TASK IDENTIFICATION TAIL -> HEAD	SCHEDULED DATA MHRS	%WT	MANHOURS PERIOD US	LS	EXPENDED TO DATE TOTAL	% COMPL
109 -> 138	63	0	122	0	231	40
109 -> 139	3360	18	40	0	40	17
109 -> 189	1120	6	6	0	805	92
123 -> 129	447	2	40	0	40	62
129 -> 131	119	0	16	0	16	39
109 -> 151	768	4	8	0	8	25
151 -> 153	400	2	20	0	32	57
153 -> 155	1672	8	20	0	56	12
155 -> 191	384	2	12	0	12	15
155 -> 157	287	1	30	0	30	11

◆◆◆ TDY PER DIEM ◆◆◆

ALLOTTED FUNDS	0.
CONSUMED FUNDS	0.
%TIME COMPLETE	32.0
%TDY EXPENDED	0.0

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